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BIOLOGICAL EVALUATION OF SOUTHERN PINE BEETLE ON NOXUBEE WILDLIFE REFUGE IN MISSISSIPPI

by

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ABSTRACT

A biological evaluation for southern pine beetle (SPB) was conducted on 48,000 acres of the Noxubee National Wildlife Refuge in Mississippi. The Noxubee Refuge had nine active spots, 26,000 acres of susceptible host type, and 0.35 spots/1,000 acres of host type. In the majority of these spots the beetles were exhibiting the winter mode of attack. Most spots were small, attacks were high on the trees, and spot growth was occurring at a slow rate. Since the spots were not expanding it is difficult to predict what population levels will be next spring. However, there are indications that beetle populations will increase again next summer. Forest Pest Management recommends a detection flight and biological evaluation early next summer and anticipates a SPB suppression project.

INTRODUCTION

A biological evaluation was conducted on the Noxubee Wildlife Refuge in Mississippi to determine the status of southern pine beetle (Dendroctonus frontalis Zimm.) populations. An entomologist and biological technician from State and Private Forestry, Forest Pest Management, Alexandria, LA, Field Office conducted the evaluation on November 8 and 9, 1982.

The Noxubee National Wildlife Refuge is located in east-central Mississippi near Starkville (fig. 1). Most of the refuge acreage

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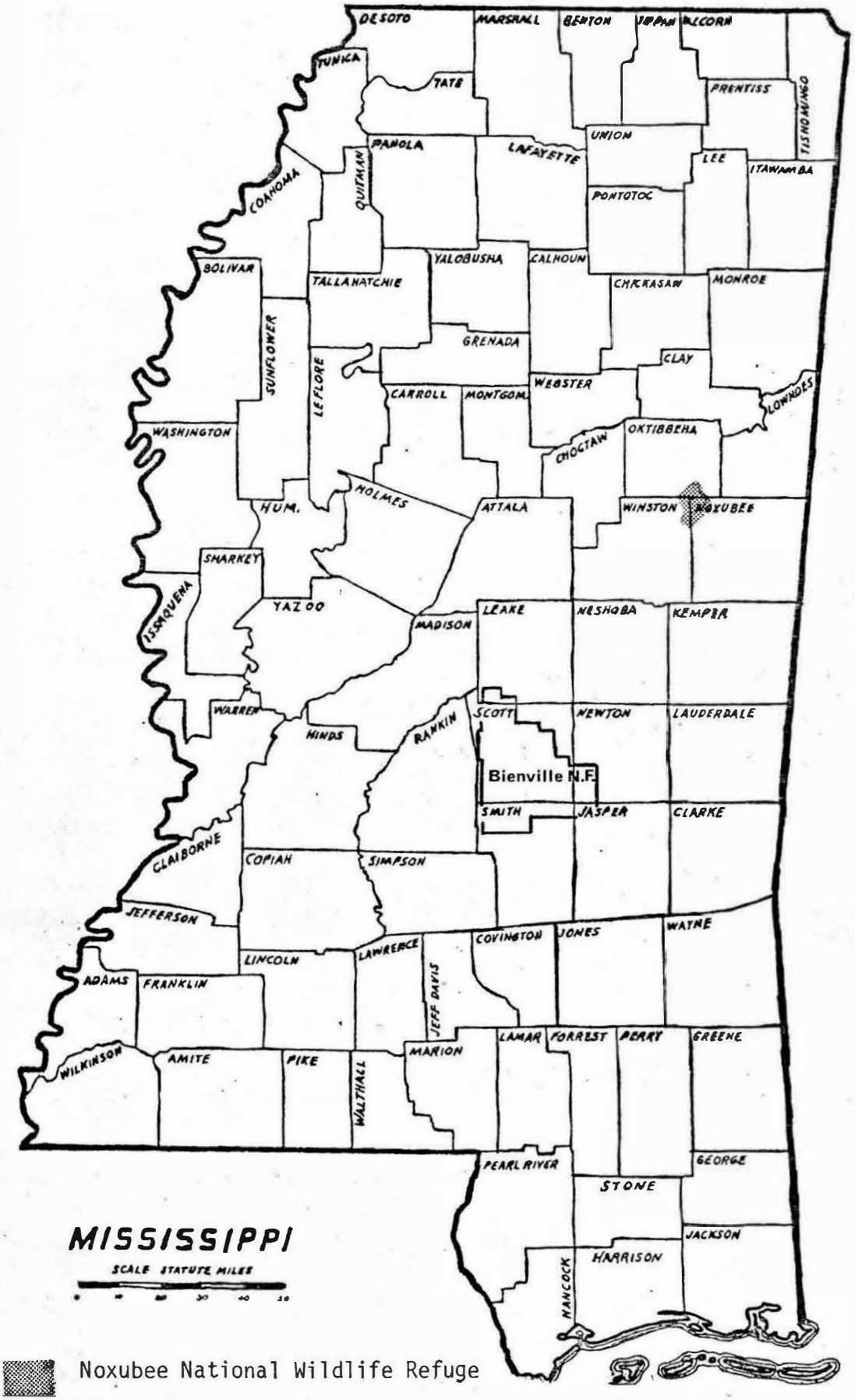

Figure 1. Location of Noxubee National Wildlife Refuge, Mississippi

was acquired by the Rural Resettlement Administration in the mid-1930's and transferred to the Fish and Wildlife Service in 1940. About 26,000 acres are pine or mixed pine hardwood. Loblolly pine, Pinus taeda L. and shortleaf pine, Pinus echinata Mill. are the predominant pine species on the refuge.

TECHNICAL INFORMATION

The southern pine beetle attacks all species of southern yellow pine. On the Noxubee Wildlife Refuge, loblolly pine, Pinus taeda L., and shortleaf pine, Pinus echinata Mill., are the preferred hosts.

Type of Damage--Damage caused by the southern pine beetle is tree mortality resulting from adult beetles constructing egg galleries in the cambial region of the host trees. Blue staining fungi (Ceratocystis spp.) introduced by the beetles and secondary insects accelerate the kill by blocking the vascular system of the tree.

Life Cycle of the Insect--The beetles attack and construct winding egg galleries in the cambium. Eggs are deposited along the galleries. White larvae hatch from the eggs and further mine the cambium and then construct pupal cells in the outer bark. After transforming to adults, the beetles emerge. During the warmer months, the life cycle is completed in about 30 days. There may be as many as seven generations each year.

METHOD OF EVALUATION AND ANALYSIS OF SPB INFESTATION

Aerial Survey and Ground Checks

Standard aerial sketch map procedures were used to conduct the aerial survey. Observers viewed a 0.5 mile wide strip on both sides of the aircraft. Flight lines were spaced so a 100% survey resulted. The survey was conducted by Fish and Wildlife personnel and spots of red and/or fading trees were recorded. All known unsalvaged spots were ground checked.

Numbers of vacated and infested trees, basal area, age, height, DBH, percentage of the stand in sawtimber and landform were recorded. This information was used to determine the volume of timber currently infested and hazard rate the stands.

Hazard Rating

All the SPB infested stands were hazard rated at the time of ground checking. This is part of FPM's effort to validate SPB hazard rating systems whenever the opportunity exists. The system used was developed by Dr. Garland Mason while at Stephen F. Austin University. It is designed for use on the Gulf Coastal Plain.

Table 1. Summary of ground check data for the Noxubee National Wildlife Refuge, Mississippi, November 1982.

Spot No.	Total No. Trees	No. Infested Trees			No. Vacated Trees				% Infested	Green:Red Ratio[a]	Age	Total Basal Area
		Total	Green	Red	Total	Green	Red	Black				
1	1	1	1	0	0	0	0	0	100	1:0	68	70
2	5	5	0	5	0	0	0	0	100	0:5	55	130
3	3	3	0	3	0	0	0	0	100	0:3	55	120
4	2	1	1	0	1	0	1	0	50	1:0	55	120
5[b]	263	101	101	0	162	0	162	0	38	101:0	45	-
6[b]	78	37	37	0	41	0	41	0	47	37:0	45	-
7	6	4	3	1	2	0	2	0	67	3:1	50	120
8[c]	2	2	2	0	0	0	0	0	100	2:0	50	120
9	18	3	3	0	15	0	15	0	17	3:0	58	110
TOTAL	378	157	148	9	221	0	221	0	-	16:1	-	-
MEAN	42	17	16	1	25	0	25	0	42	16:1	53	113

[a] Based on infested trees only.

[b] Spot partially salvaged and data reconstructed from tally sheets, therefore, no basal area could be obtained.

[c] Breakout from spot previously cut.

Table 2. SPB hazard rating summary for infestation locations, Noxubee National Wildlife Refuge, Mississippi, November 1982.

Spot No.	Total Basal Area	Pine Basal Area	Total Tree Height	Site Index	Diameter (in.)	Age	Predominant Pine Species	Landform	SPB Hazard Rating
1	70	70	93	90	16	68	Loblolly	Ridge	Low
2	130	110	95	90	16	55	Loblolly	Ridge	Moderate
3	120	100	95	90	16	55	Loblolly	Ridge	Moderate
4	120	110	95	90	16	55	Loblolly	Sideslope	Moderate
5	*	*	85	90	14	45	Loblolly	Sideslope	*
6	*	*	88	90	14	45	Loblolly	Bottom	*
7	120	110	85	90	14	50	Loblolly	Sideslope	Moderate
8	120	100	90	90	12	50	Loblolly	Bottom	High
9	110	90	78	80	12	58	Loblolly	Sideslope	Moderate
MEAN	113	99	89	89	14	53	-	-	-

* Spot had been partially logged so no basal area could be obtained. Therefore, no hazard rating could be determined.

RESULTS

A total of 14 active multiple tree spots have been recorded this year. Nine spots were ground checked by FPM during the evaluation and the data are summarized in table 1. The ground checked spots range in size from 1 to 263 infested trees. The mean ratio of green infested: red infested trees was 16:1. This ratio was high because the larger spots had already been salvaged and the remaining spots were typical of spots in the winter mode of activity. They were relatively small in size, beetle attacks were high on the infested trees, and crowns were not fading because of cooler temperatures. An estimated volume of 41 MBF of timber is currently infested. Due to the small amount of timber currently infested no economic evaluation was conducted.

Of the 9 infestations checked only 7 were hazard rated (2 were in the process of being salvaged and basal areas could not be obtained). One rated as high, one low, and 5 medium risk to SPB attack (table 2). Larger SPB infestations may be expected when hazard ratings are higher.

DISCUSSION

Southern pine beetle activity varies by the season of the year. During the warm summer months, the short time required for completion of a generation and the presence of attractants concentrates beetles in and maintains the expansion of spots. During the fall and winter, spot growth slows down, partly because of cooler temperatures and longer times required for beetle development. In the fall and spring many beetles disperse from active spots and infest trees which may be some distance from the point of dispersal. As temperatures warm in late spring and early summer, beetle activity increases and many new previously undetected spots may appear.

Since the transition of beetle activity into the winter mode was occurring when this evaluation was conducted, it is difficult to predict how much spot growth will take place for the remainder of this year. Likewise, there are no reliable population dynamics models which will predict SPB activity next spring based on activity this fall. Even though the ground checked spots were small, several spots were only a few hundred yards apart. Most trees that had been lightning struck had evidence of beetle attacks. In addition, other nearby forest lands also experienced increased southern pine beetle activity late this summer. Therefore, there are indications that beetle activity will continue to increase next year.

RECOMMENDATIONS

A suppression project is not warranted at this time because of the small volume of timber currently infested. However, the increase in SPB activity this summer is expected to continue next year. Forest Pest Management recommends a detection flight and biological evaluation be conducted early next summer and anticipates a SPB suppression project.

A detailed description of control alternatives is presented in Appendix I. (Note: cut-and-leave used alone is not an effective method of control from October through April). Control efforts during winter months will be hindered as new spots may not be located until trees begin fading in late spring.

If mill quotas are established next spring creating problems in salvaging spots, we recommend cutting only the buffer strip and infested trees, leaving vacated trees standing. This procedure will control SPB spots and reduce the amount of timber going to markets. The remaining vacated trees will provide some value as wildlife snags.

As spots become easier to find next spring, priorities for control should be established using Southern Pine Beetle Fact Sheet No. 3 (USDA Forest Service 1979) or Texas Forest Service Circular 249 (Billings and Hynum 1980) (Appendix I). Also, spots in high and medium hazard stands are more likely to increase in size and should receive priority for removal.

ACKNOWLEDGEMENT

We wish to thank Craig Hayes and George Chastain for the cooperation and the field assistance they provided.

Appendix I

ALTERNATIVES FOR SOUTHERN PINE BEETLE CONTROL

Five alternatives are recommended for southern pine beetle control. The following discussion briefly outlines these alternatives (Swain & Remion 1980). For a more detailed description on conducting control procedures in a southern pine beetle suppression project refer to the Project Control Plan or to the southern pine beetle handbook series (Agric. Handb. Nos. 558, 560, 575, 576).

Alternative 1. Remove trees through salvage.

Salvage is the method most often used for stopping the growth of existing spots. This strategy involves removing a buffer strip of noninfested trees, all green infested and red infested trees, and if desired, the trees already killed by the beetles. Costs associated with removing uninfested trees are not charged to specifically designated SPB Project Control Funds since removing uninfested material is not needed for successful control even though it may be operationally desirable. The buffer strip should surround the recently attacked trees. It should be 40 to 70 feet wide for most active spots, while a 100-ft strip (and occasionally larger) may be needed for large, rapidly expanding spots. As a rule, the width of the buffer should not exceed the average height of the trees in the spot. The SPB spot should be carefully surveyed and all trees to be removed should be marked.

To implement this alternative the buffer strip should be cut first. All infested trees should then be cut. Vacated trees are cut last and are removed only for utilization purposes. All trees should be felled toward the center of the spot. The reason for this is to keep infested trees as far away from noninfested trees as possible. This reduces the chance of beetles killing additional trees.

Alternative 2. Piling and burning.

Unmerchantable or inaccessible southern pine beetle infestations can be suppressed by cutting, piling, and thoroughly charring the bark of infested trees. The entire bark surface must be thoroughly charred to insure effective control. The order of priority for cutting, piling, and burning infested trees, particularly in large spots, is the same for Alternative 1. Cutting a buffer strip is not recommended. To reduce the possibility of "breakouts", every effort should be made to locate and treat all green infested trees during the piling and burning operation.

Alternative 3. Cut-and-leave infested trees.

This is accomplished by felling a buffer strip and all infested trees toward the center of the spot. The purpose is to stop spot growth. Use of this method causes beetles to disperse at a time of year when this behavior is

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This is accomplished by felling a buffer strip and all infested trees toward the center of the spot. The purpose is to stop spot growth. Use of this method causes beetles to disperse at a time of year when this behavior is

unnatural. This results in a reduction of mass attacked trees and spot growth ceases. Cut-and-leave should only be used in the summer (May 1 - September 30), since these are the only months beetles are not dispersing. It should only be used on small spots, normally 50 infested trees or less.

If spots are greater than 50 infested trees cut-and-leave could be used, but these areas should be monitored biweekly for at least 2 months to insure that a breakout does not occur.

Alternative 4. Chemically treat infested trees.

In this method, infested trees are felled toward the center of the spot, cut into workable lengths, and sprayed with lindane or Dursban® 4E. The purpose of this method is to kill the beetle population. To be effective, all bark surfaces must be sprayed. This involves turning the logs which becomes more difficult as tree size increases.

Forest Pest Management, Alexandria Field Office, Pineville, LA, should be contacted prior to the extensive use of chemical control for an update on latest restrictions or application procedures.

Alternative 5. No action.

SPB populations increase periodically. When they increase, large numbers of susceptible pines are killed. This may occur from one to several years until the infestations are brought under control by parasites, predators, weather or lack of suitable host material. The disadvantage of this option is the possibility of additional tree losses, before natural control of the infestation occurs. Advantages in utilizing this option are: 1) no cost and 2) no artificial disruption of the environment.

PRECAUTIONARY STATEMENT

Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels.

Store pesticides in their original containers under lock and key out of reach of children and animals, and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear appropriate protective clothing.

If your hands become contaminated with a pesticide, wash them immediately with soap and water. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove the clothing immediately and wash skin thoroughly. After handling or spraying pesticides, do not eat or drink until you have washed with soap and water.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicide from equipment, do not use the same equipment for insecticides or fungicides that you used for herbicides.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary landfill dump, or crush and bury them in a level, isolated place.

NOTE: Some states have restrictions on the use of certain pesticides. Check your state and local regulations. Also, because registrations of pesticides are under constant review by the U.S. Environmental Protection Agency, consult your county agent, state extension specialist or FPM to be sure it is still registered for the intended use. For further information or assistance, contact Forest Pest Management, Alexandria Field Office, Pineville, La., 71360, (Telephone: FTS 497-7280, or Commercial 318/473-7280).

Southern Pine Beetle

Guide for Predicting Timber Losses from Expanding Spots in East Texas

by

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Circular 249 **March 1980**

TEXAS FOREST SERVICE
A Part of
The Texas A&M University System

Many southern pine beetle infestations (SPB spots) enlarge during warm months if no direct control is applied. Other spots are abandoned by emerging beetles soon after detection with little or no additional loss of trees. The extent of timber losses from spot expansion will depend on the initial size of the infestation and the density (basal area) of the stand. The following steps describe how to predict tree and dollar losses from spot spread over a 30 day period during summer months. This estimate is useful for making better control decisions.

1. Examine the spot to determine if trees with fresh SPB attacks (stage 1) are present. See USDA Agricultural Handbook 558 for details. If there are no fresh attacks, no additional spot spread is likely to occur and the spot will probably be inactive within 30 days.

2. If freshly-attacked trees are present, count or estimate the total number of active trees in the spot. Active trees include trees with fresh attacks (stage 1) as well as those with SPB larvae, pupae or new adults (stage 2).

3. Estimate the stand basal area (in ft^2/acre) at the active head(s) of the spot, using a 10 factor prism. (Stand basal area = basal area of pines + hardwoods.)

4. From Table 1 (on reverse side) determine the additional tree losses to be expected after 30 days. *This estimate does not include the trees already dead or currently infested with beetles.*

5. To estimate the dollar loss to be expected from spot expansion over the next 30 days, use the following formula:

Expected dollar loss = A x B x C

where:

A = additional trees killed from Table 1.
B = average volume per tree.
C = stumpage price per unit volume.

6. For a given spot, the value in Table 1 for "trees remaining active" is an estimate of the number of active trees to be expected at day 30. This value, when compared to number of active trees at day 0, indicates whether the level of beetle activity in the spot is likely to increase or decrease if no control is applied.

Example Of How To Figure Dollar Losses

Question: What are the tree and dollar losses to be expected after 30 days from a spot of 75 active trees in a uniform sawtimber stand of 150 ft^2/acre basal area if average volume/tree = 100 bd. ft and stumpage price = $250/MBF?

Answer: From Table 1, additional trees killed after 30 days = 62.

Additional dollar loss = (62 trees) x (100 bd. ft/tree) x ($0.25/bd. ft) = *$1550.*

In other words, if this spot is not controlled, the landowner can expect to loose 62 more trees in the next 30 days, valued at $1550. This loss is in addition to trees already infested or dead.

TABLE 1

Additional Timber Losses To Be Expected From Spot Growth Over 30 Days During Summer in East Texas[1]

Number of Active Trees At Day 0[2]		Total Stand Basal Area (ft²/acre)			
		20-60	70-110	120-160	170-210
		Predicted Value at Day 30			
5	Additional trees killed[3]	0	0	0	0
	Trees remaining active[4]	≤ 1	≤ 1	≤ 1	≤ 1
10	Additional trees killed	0	0	2	5
	Trees remaining active	≤ 2	≤ 2	4	7
20	Additional trees killed	0	5	12	18
	Trees remaining active	≤ 4	9	16	22
30	Additional trees killed	2	12	21	30
	Trees remaining active	8	18	27	36
50	Additional trees killed	9	24	39	54
	Trees remaining active	18	33	48	63
75	Additional trees killed	16	39	62	84
	Trees remaining active	30	53	76	98
100	Additional trees killed	24	54	84	115
	Trees remaining active	43	73	103	134

[1]To be used for evaluating spots in East Texas during months of June-October only.

[2]Number of stage 1 + stage 2 trees present when spot growth prediction is made.

[3]Predictions for "additional trees killed" derived from Texas Forest Service spot growth model (based on 1975 data):

$$ATK = [(0.000202\ IAT \times TBA) - 0.2211] \times 30$$

where ATK = number of additional trees killed by day 30
IAT = number of active trees at day 0
TBA = total basal area in ft²/acre

[4]Predictions for "trees remaining active" (TRA) based on SPB developmental rate of 37 days and formula:

$$TRA = ATK + \frac{7}{37}(IAT)$$

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FOREST INSECT AND DISEASE MANAGEMENT

Technology Update

Southeastern Area, State and Private Forestry, 1720 Peachtree Road, N.W., Atlanta, Ga. 30309

Southern Pine Beetle Fact Sheet
Number 3

SETTING CONTROL PRIORITIES FOR THE SOUTHERN PINE BEETLE*

All southern pine beetle spots (groups of infested trees) do not have the same control priority. The following guidelines should help you set priorities for controlling individual spots.

A. Classify the infested trees according to the stage of attack shown below.

Symptom	Stage 1 Fresh attacks	Stage 2 Developing broods	Stage 3 Vacated trees
Foliage	Green	Green, trees with larvae; fade to yellow before new generation.	Red, needles falling.
Pitch tubes	Soft white, light pink,	White, hardened.	Hard, yellow, crumbles easily.
Checkered beetles	Adults crawl on the bark.	Larvae in SPB galleries; pink or red; 1/2 inch long.	Larvae and pupae are purple; occur in pockets in the outer bark.
Bark	Tight, hard to remove.	Loose, peels easily.	Very loose, easily removed.
Color of wood surface	White, except close to new adult galleries.	Light brown with blue or black sections.	Dark brown to black, may have sawyer galleries.
Exit holes	----	May appear where parent beetles left the tree.	Numerous
Ambrosia beetle dust	---- ----	White, begins to appear around the base of trees.	Abundant at the base of trees.

*Compiled from a handbook of the Texas Forest Service. It will be published this fall by the USDA's Expanded Southern Pine Beetle Research and Applications Program.

B. Collect spot expansion data:

1. Walk completely around the spot and look for stage 1 trees, which indicate the area of most recent beetle activity. Areas with stage 1 pines are called "Active heads." Check to see if the spot is expanding in more than one direction. Large spots can have more than one active head.

2. Determine the number of stage 1 and 2 trees. For large spots that have more than 50 trees, it is not necessary to examine each tree. Just walk the boundaries and estimate the number of these trees in the spot.

3. From a location about 20 feet (6 m) in front of the active head(s), determine the pine basal area (a measure of stand density) in square feet per acre. A 10-factor prism is useful for this purpose.

4. Note whether most trees in the spot are pulpwood (less than 9 inches in diameter) (23 cm) or sawtimber size (more than 9 inches in diameter).

5. If only stage 3 trees are present, control is not necessary.

6. Determine the control priority for the spot, using the guide on the next page (item C).

C. Guide to southern pine beetle control priorities (May through October):

Key to spot growth	Your spot's classification	risk-rating points
A. Stage 1 trees	absent	0
	present	30
B. Stage 1 and 2 trees	1 to 10	0
	11 to 20	10
	21 to 50	20
	more than 50	40
C. Pine basal area (ft^2/a) or stand density at active head or heads	less than 80 (low density)	0
	80 to 120 (medium density)	10
	more than 120 (high density)	20
D. Stand class by average d.b.h. (in inches)	pulpwood (9 inches or less)	0
	sawtimber (more than 9 inches)	10

	Buffer strip width (feet)
If total is: 70 to 100.....control priority is: High	40 to 100
If total is: 40 to 60.....control priority is: Medium	10 to 40
If total is: 0 to 30.....control priority is: Low	10 to 40